

# BUG FIX

SIM -> **DIGIT** -> CLUSTER

Digitizer currently converts **floats** to **integers**: which means shape of cloud is affected both in maximum and in shape

Snapshot of cells array in the neighbourhood of local maximum:

```
maxima found in window rphi z 8 6
max 4
0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 2.00 | 3.00 | 3.00 | 3.00 | 2.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 |
0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 2.00 | 3.00 | 4.00 | 4.00 | 3.00 | 2.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 |
0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 2.00 | 3.00 | 3.00 | 4.00 | 3.00 | 2.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 |
0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 1.00 | 2.00 | 2.00 | 2.00 | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 |
0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
FIT | phi -2.02429 from -2.02486 | z -5.49784 from -5.52356
cluster fitted
| rad 73.795 | size rp z 0.483869 0.509867 | error_rphi error_z 0.0117515 0.0119404
| sgn 76 | rphi z -149.383 -5.49784 | phi_sig z_sig phiz_cov 0.00138826 0.104094 -1.86912e-06
inserted
```

Trouble comes since the contents of each cell is the fraction of electrons without amplification.

# BUG FIX

SIM -> **DIGIT** -> CLUSTER

Digitizer currently converts **floats** to **integers**: which means shape of cloud is affected both in maximum and in shape

Snapshot of cells array in the neighbourhood of local maximum: (after fix)


```
=> nhits_tot 389
maxima found in window rphi z 8 6
max 2405
0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
0.00 | 0.00 | 0.00 | 2.00 | 4.00 | 7.00 | 11.00 | 13.00 | 14.00 | 12.00 | 8.00 | 5.00 | 2.00 | 1.00 | 0.00 | 0.00 |
0.00 | 1.00 | 4.00 | 12.00 | 25.00 | 43.00 | 64.00 | 78.00 | 80.00 | 69.00 | 49.00 | 30.00 | 15.00 | 6.00 | 2.00 | 0.00 |
1.00 | 6.00 | 19.00 | 48.00 | 99.00 | 173.00 | 252.00 | 308.00 | 316.00 | 272.00 | 196.00 | 119.00 | 60.00 | 25.00 | 9.00 | 2.00 |
5.00 | 18.00 | 54.00 | 134.00 | 278.00 | 483.00 | 703.00 | 859.00 | 881.00 | 758.00 | 547.00 | 331.00 | 168.00 | 71.00 | 25.00 | 7.00 |
10.00 | 36.00 | 107.00 | 264.00 | 546.00 | 949.00 | 1383.00 | 1690.00 | 1733.00 | 1490.00 | 1076.00 | 651.00 | 331.00 | 141.00 | 50.00 | 15.00 |
14.00 | 50.00 | 148.00 | 366.00 | 759.00 | 1318.00 | 1919.00 | 2346.00 | 2405.00 | 2069.00 | 1493.00 | 904.00 | 459.00 | 195.00 | 70.00 | 21.00 |
14.00 | 49.00 | 145.00 | 359.00 | 744.00 | 1292.00 | 1882.00 | 2299.00 | 2358.00 | 2028.00 | 1464.00 | 886.00 | 450.00 | 192.00 | 68.00 | 20.00 |
9.00 | 34.00 | 100.00 | 248.00 | 515.00 | 894.00 | 1302.00 | 1592.00 | 1632.00 | 1404.00 | 1013.00 | 613.00 | 311.00 | 132.00 | 47.00 | 14.00 |
4.00 | 16.00 | 49.00 | 121.00 | 251.00 | 437.00 | 636.00 | 778.00 | 798.00 | 686.00 | 495.00 | 300.00 | 152.00 | 64.00 | 23.00 | 6.00 |
1.00 | 5.00 | 17.00 | 41.00 | 86.00 | 150.00 | 219.00 | 268.00 | 275.00 | 236.00 | 170.00 | 103.00 | 52.00 | 22.00 | 8.00 | 2.00 |
0.00 | 1.00 | 4.00 | 10.00 | 21.00 | 36.00 | 53.00 | 65.00 | 67.00 | 57.00 | 41.00 | 25.00 | 12.00 | 5.00 | 1.00 | 0.00 |
0.00 | 0.00 | 0.00 | 1.00 | 3.00 | 6.00 | 9.00 | 11.00 | 11.00 | 9.00 | 7.00 | 4.00 | 2.00 | 0.00 | 0.00 | 0.00 |
FIT | phi -2.02594 from -2.02565 | z -5.74368 from -5.77849
cluster fitted
| rad 77.395 | size rp z 0.604609 0.679823 | error_rphi error_z 0.022416 0.0225176
| sgn 30.377 | rphi z -156.798 -5.74368 | phi_sig z_sig phiz_cov 0.00159631 0.124107 -2.66064e-07
inserted
```



**Fix by adding a constant amplification factor in the SIM and CLUSTER.**


**The amplification factor allows for a more define cloud shape and makes the clusterizer fitter work better.**

**The factor is used to recover the number effective electrons.**

# SIM

2  simulation/g4simulation/g4detectors/PHG4CylinderCellTPCReco.cc

View  

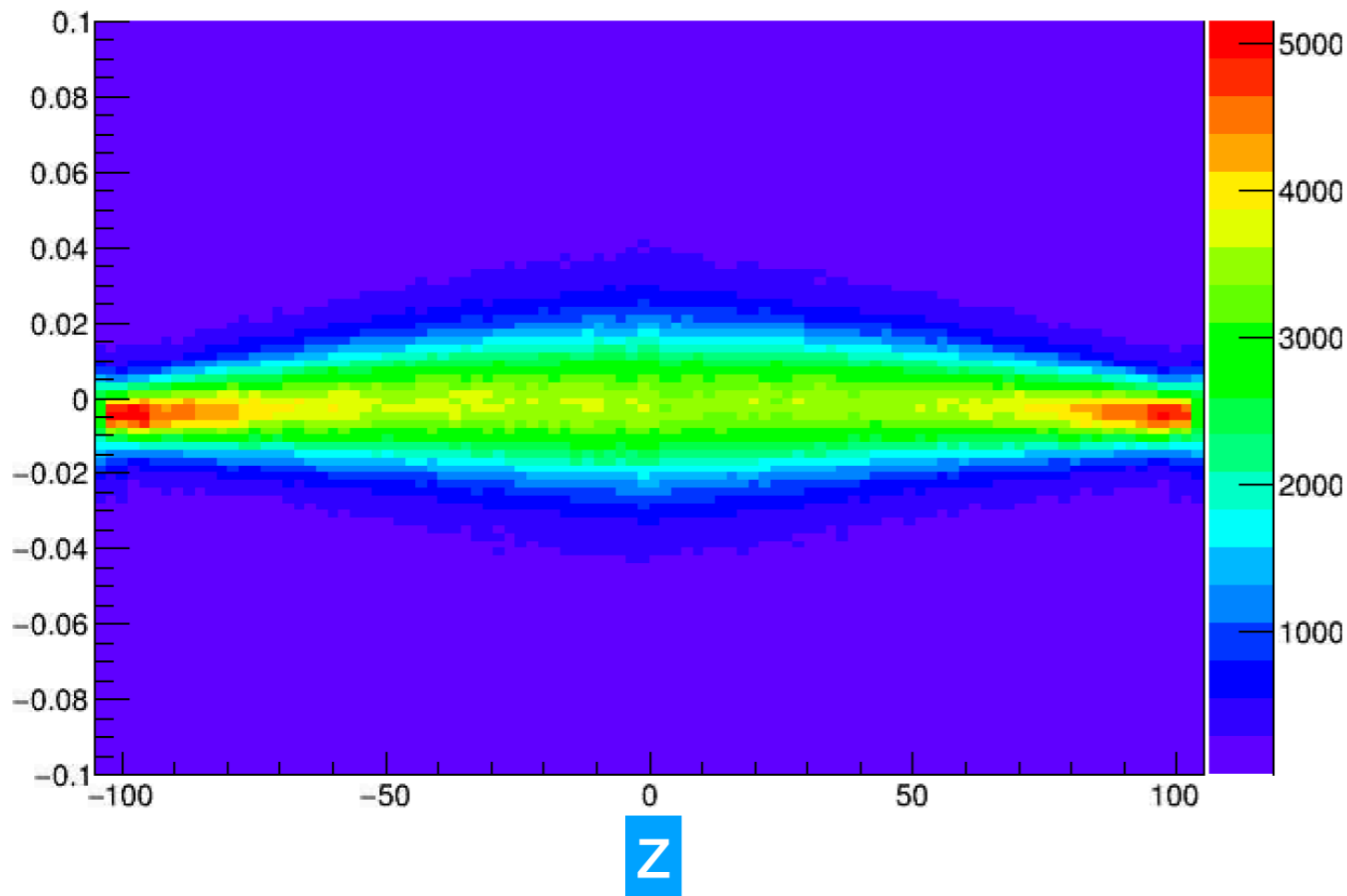
	@@ -403,7 +403,7 @@ int PHG4CylinderCellTPCReco::process_event(PHCompositeNode *topNode)	
403	double zLim1 = 0.5*M_SQRT2*( (iz+0.5)*zstepsize - zdisp )*cloud_sig_zz_inv;	403 double zLim1 = 0.5*M_SQRT2*( (iz+0.5)*zstepsize - zdisp )*cloud_sig_zz_inv;
404	double zLim2 = 0.5*M_SQRT2*( (iz-0.5)*zstepsize - zdisp )*cloud_sig_zz_inv;	404 double zLim2 = 0.5*M_SQRT2*( (iz-0.5)*zstepsize - zdisp )*cloud_sig_zz_inv;
405	double z_integral = 0.5*( erf(zLim1) - erf(zLim2) );	405 double z_integral = 0.5*( erf(zLim1) - erf(zLim2) );
406	- float neffelectrons = nelec*( phi_integral * z_integral );	406 + float neffelectrons = 2000*nelec*( phi_integral * z_integral ); // adding constant electron avalanche (value chosen so that digitizer will not trip)
407	if(verbosity>1000) {	407 if(verbosity>1000) {
408	std::cout << Form("%.3f",neffelectrons) << " ";	408 std::cout << Form("%.3f",neffelectrons) << " ";
409	if( iz == n_zz ) std::cout << std::endl;	409 if( iz == n_zz ) std::cout << std::endl;
		

# CLUSTERIZER

26 <div><div></div><div></div><div></div><div></div></div> simulation/g4simulation/g4hough/PHG4TPCClusterizer.C		<div>View</div> <div><div></div><div></div><div></div></div>	
<div><div></div> @@ -332,17 +338,17 @@ int PHG4TPCClusterizer::process_event(PHCompositeNode* topNode) {</div>			
332	if(!is_local_maximum(phibin, zbin)) continue;	338	if(!is_local_maximum(phibin, zbin)) continue;
333	if(verbosity>2000) std::cout << " maxima found in window rphi z " << fFitRangeP << " " << fFitRangeZ << std::endl;	339	if(verbosity>2000) std::cout << " maxima found in window rphi z " << fFitRangeP << " " << fFitRangeZ << std::endl;
334	fit(phibin,zbin,nhits_tot);	340	fit(phibin,zbin,nhits_tot);
335	- if(fFitW < fEnergyCut) continue; // ignore this cluster	341	+ if(fFitW/2000 < fEnergyCut) continue; // ignore this cluster
336	SvtxCluster_v1 clus;	342	SvtxCluster_v1 clus;
337	clus.set_layer(layer);	343	clus.set_layer(layer);
338	- clus.set_e( fFitW );	344	+ clus.set_e( fFitW/2000 );
339	float phi = fit_p_mean();	345	float phi = fit_p_mean();
340	float pp = radius*phi;	346	float pp = radius*phi;
341	float zz = fit_z_mean();	347	float zz = fit_z_mean();
342	float pp_err = radius * fGeoLayer->get_phistep() * _inv_sqrt12;	348	float pp_err = radius * fGeoLayer->get_phistep() * _inv_sqrt12;
343	float zz_err = fGeoLayer->get_zstep() * _inv_sqrt12;	349	float zz_err = fGeoLayer->get_zstep() * _inv_sqrt12;
344	- if(fFitSizeP>1) pp_err = radius * TMath::Sqrt( fit_p_cov()/fFitW );	350	+ if(fFitSizeP>1) pp_err = radius * TMath::Sqrt( fit_p_cov()/fFitW/2000 );
345	- if(fFitSizeZ>1) zz_err = TMath::Sqrt( fit_z_cov()/fFitW );	351	+ if(fFitSizeZ>1) zz_err = TMath::Sqrt( fit_z_cov()/fFitW/2000 );
346	//float rr_err = fGeoLayer->get_thickness() * _inv_sqrt12;	352	//float rr_err = fGeoLayer->get_thickness() * _inv_sqrt12;
347	//float sinphi = TMath::Sin(phi);	353	//float sinphi = TMath::Sin(phi);
348	//float cosphi = TMath::Cos(phi);	354	//float cosphi = TMath::Cos(phi);
<div><div></div> @@ -356,13 +362,13 @@ int PHG4TPCClusterizer::process_event(PHCompositeNode* topNode) {</div>			
356	//float xx_size = TMath::Sqrt(pp_size*sinphi*pp_size*sinphi + fGeoLayer->get_thickness()*cosphi*fGeoLayer->get_thickness()*cosphi); // linearization	362	//float xx_size = TMath::Sqrt(pp_size*sinphi*pp_size*sinphi + fGeoLayer->get_thickness()*cosphi*fGeoLayer->get_thickness()*cosphi); // linearization
357	//float yy_size = TMath::Sqrt(pp_size*cosphi*pp_size*cosphi + fGeoLayer->get_thickness()*sinphi*fGeoLayer->get_thickness()*sinphi); // linearization	363	//float yy_size = TMath::Sqrt(pp_size*cosphi*pp_size*cosphi + fGeoLayer->get_thickness()*sinphi*fGeoLayer->get_thickness()*sinphi); // linearization
358	if(verbosity>1) {	364	if(verbosity>1) {
359	- FHClusterEnergy->Fill(fFitW);	365	+ FHClusterEnergy->Fill(fFitW/2000);
360	- FHClusterDensity->Fill(layer,zz,fFitW);	366	+ FHClusterDensity->Fill(layer,zz,fFitW/2000);
361	FHClusterSizePP->Fill(layer,zz,pp_size);	367	FHClusterSizePP->Fill(layer,zz,pp_size);
362	FHClusterSizeZZ->Fill(layer,zz,zz_size);	368	FHClusterSizeZZ->Fill(layer,zz,zz_size);
363	FHClusterErrorPP->Fill(layer,zz,pp_err);	369	FHClusterErrorPP->Fill(layer,zz,pp_err);
364	FHClusterErrorZZ->Fill(layer,zz,zz_err);	370	FHClusterErrorZZ->Fill(layer,zz,zz_err);
365	- FHClusterDensity2->Fill(phi,zz,fFitW);	371	+ FHClusterDensity2->Fill(phi,zz,fFitW/2000);
366	FHClusterSizePP2->Fill(phi,zz,pp_size);	372	FHClusterSizePP2->Fill(phi,zz,pp_size);
367	FHClusterSizeZZ2->Fill(phi,zz,zz_size);	373	FHClusterSizeZZ2->Fill(phi,zz,zz_size);
368	FHClusterErrorPP2->Fill(phi,zz,pp_err);	374	FHClusterErrorPP2->Fill(phi,zz,pp_err);
<div><div></div> @@ -376,7 +382,7 @@ int PHG4TPCClusterizer::process_event(PHCompositeNode* topNode) {</div>			
376	std::cout << "   rad " << radius;	382	std::cout << "   rad " << radius;
377	std::cout << "   size rp z " << pp_size << " " << zz_size;	383	std::cout << "   size rp z " << pp_size << " " << zz_size;
378	std::cout << "   error_rphi error_z " << pp_err << " " << zz_err << std::endl;	384	std::cout << "   error_rphi error_z " << pp_err << " " << zz_err << std::endl;
379	- std::cout << "   sgn " << fFitW;	385	+ std::cout << "   sgn " << fFitW/2000;
380	std::cout << "   rphi z " << pp << " " << zz;	386	std::cout << "   rphi z " << pp << " " << zz;
381	std::cout << "   phi_sig z_sig phiz_cov " << TMath::Sqrt(fit_p_cov()) << " " << TMath::Sqrt(fit_z_cov()) << " " << fit_pz_cov();	387	std::cout << "   phi_sig z_sig phiz_cov " << TMath::Sqrt(fit_p_cov()) << " " << TMath::Sqrt(fit_z_cov()) << " " << fit_pz_cov();
382	std::cout << std::endl;	388	std::cout << std::endl;
<div><div></div></div>			

$\sqrt{x^2+y^2} \cdot \text{atan2}(y,x) - \sqrt{g_x^2+g_y^2} \cdot \text{atan2}(g_y,g_x) : z \{ \text{layer} > 6 \}$

Delta (RPhi)

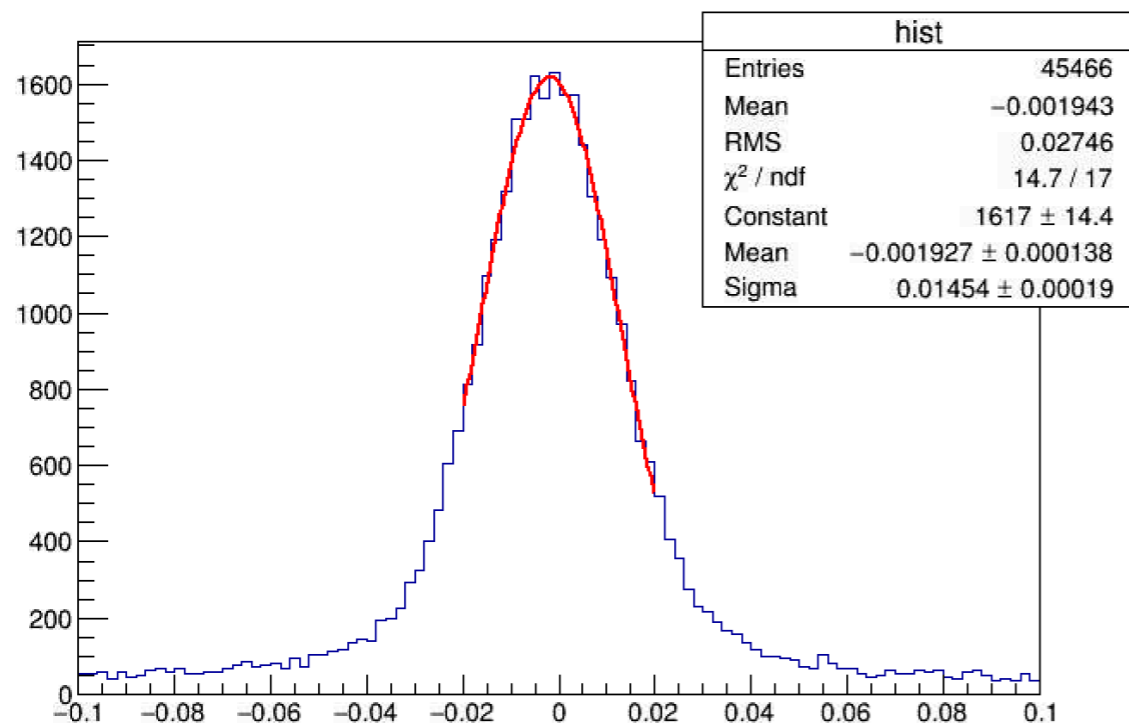


## TPC Cluster Evaluation

### Central Hijing Events

#### Delta(RPhi) @ Z = 4.5 cm

$\sqrt{x^2+y^2} \cdot \text{atan2}(y,x) - \sqrt{g_x^2+g_y^2} \cdot \text{atan2}(g_y,g_x) \{ \text{layer} > 6 \&\& z > 3 \&\& z < 4 \}$



#### Delta(RPhi) @ Z = 60.5 cm

$\sqrt{x^2+y^2} \cdot \text{atan2}(y,x) - \sqrt{g_x^2+g_y^2} \cdot \text{atan2}(g_y,g_x) \{ \text{layer} > 6 \&\& z > 60 \&\& z < 61 \}$

